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(19) (CA) **CANADIAN PATENT** (12)

(54) Multiple Superimposed Latent Images

(72) Merry, Trevor,
Canada

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Canada

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ABSTRACT

A method of generating overlying line deflection patterns on a substrate for security or authentication purposes or the like, and the resulting security device produced by the method, are provided. A first line deflection pattern is applied to the substrate producing a first visible image when overlain by a finding screen. A second line deflection pattern is applied to the substrate so as to overlie at least a substantial portion of the first line deflection pattern. The second line deflection pattern produces a second visible image when overlain by a finding screen. The second line deflection pattern is given at least one visual characteristic (e.g., angle of orientation) different from the counterpart characteristic of the first line deflection pattern, thereby enabling discrimination of the two visible images with the aid of the finding screen.

Introduction

By the method of this invention, superimposed patterns may be produced on a substrate such as paper which, to the unaided eye, contain no useful information, but which, when viewed with a "finding screen", can be seen to consist of two or more discrete images which appear to occupy the same area of the substrate. This is a useful security measure for documents such as banknotes, share certificates, etc.

Line deflection patterns are produced from different subjects and are then superimposed. They may have substantially the same angle of orientation, in which case they are offset by an appropriate preferred distance as discussed below. Alternatively, line deflection patterns of different subjects may be superimposed at various angles. They may in some cases be of different colors.

By means of a finding screen, the hidden images may be perceived by orienting the finding screen at the same angle as the line patterns. Where the patterns are superimposed at the same angle of orientation, the various images are revealed by shifting the finding screen through the offset distance. Where the patterns are superimposed at different angles, the hidden images are revealed by rotating the finding screen about the superimposed line deflection patterns.

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BACKGROUND OF THE INVENTION

It is known to create on a printed article a pattern which does not readily convey meaningful information to the unaided eye, but which conveys meaningful information (e.g. a readily recognizable image) when a "finding screen" viz. a screen having a predetermined line pattern or the like, is superimposed upon the printed article. Such a method has been used as an anti-counterfeiting measure in security printing.

As described in Canadian Patent No. 1,066,109, which issued on 13 November, 1979, to Canadian Bank Note Company, Limited, it is also known to generate a line deflection pattern by combining a line negative (obtained by photographing an object through a line screen) and a line positive obtained from the line negative.

Using this known method, an object is photographed in conventional manner on high-contrast film through a line screen to obtain a line negative in which bright areas are reproduced as lines of uniform maximum width and dark areas are reproduced as lines of uniform minimum width. The exposure is arranged so that the lines of maximum width are separated from one another by a distance equal to the width of any of the lines of minimum width. Grey or transition areas are reproduced as tapering lines of width varying from the maximum to the minimum.

A positive of the negative is then developed. The positive is superimposed upon the negative almost exactly in register but with the lines of the positive offset from the lines of the negative through a distance

equal to the said minimum width. A line deflection pattern is thereby created, being a set of spaced lines in which light intensity differences are reproduced as deviations of the lines from the line pattern of the line screen.

SUMMARY OF THE INVENTION

According to the present invention, a method of generating overlying line deflection patterns on a substrate (e.g. paper) for security or authentication purposes or the like is provided. A first line deflection pattern is applied to the substrate producing a first visible image when overlain by a finding screen. A second line deflection pattern is applied to the substrate so as to overlie at least a substantial portion of the first line deflection pattern. The second line deflection pattern also produces a second visible image when overlain by a finding screen. Somewhat surprisingly, the two patterns can nevertheless be distinguished from one another with the assistance of a finding screen. The superimposition of patterns tends to generate to the unaided eye a jumble of lines lacking decipherable visual content, which is a security advantage over and above the advantages arising out of the practice of the invention of Canadian Patent No. 1,066,109 to generate single line deflection patterns. The second line deflection pattern is given at least one visual characteristic different from the counterpart characteristic of the first line deflection pattern, thereby enabling discrimination of the two visible images with the aid of the finding screen.

The term "finding screen" is used to describe a screen having a predetermined line pattern. An example of a finding screen is a transparent sheet of material with a solid line pattern applied to the sheet. Another example could be light transmitted from a source or sources such that the transmitted light falling upon a substrate would produce a pattern of bright and shaded areas. An example of a suitable light source would be a laser.

One of the patterns may be applied by printing and the other by embossing or both patterns may be applied by printing. Other suitable means of applying the patterns may also be devised. The first and second line deflection patterns should have substantially the same frequency (of lines per inch) or one should have a frequency which is a low integral multiple of the frequency of the other.

The visual characteristic of one line deflection pattern which is different from the other line deflection pattern may be the angle of orientation of the patterns in which case an interlaced pattern of the line deflection patterns combined is obtained. The latent images are alternatively revealed by rotating a finding screen about the combined pattern. Another differing visual characteristic may be the color of the patterns, although color alone may not be sufficient to enable discrimination. Contrasting inks may nevertheless be used for each of the superimposed line deflection patterns thereby resulting in a multi-colored imprinted pattern. The angle of orientation of the two patterns may be substantially the same, in which case, if only a single finding screen is to be used, at least one of the differing

visual characteristics is the phase of the patterns, in other words, the first pattern is offset from the second pattern. If only two patterns of the same frequency are used, one should be offset from the other by approximately half the interlineation distance (i.e. wavelength) of the patterns.

Depending upon the visual characteristics of the patterns, it may be possible to provide a third such line deflection pattern in overlying relationship with the first two. It will be appreciated that the greater the number of overlying patterns, the greater the jumble of lines or "messiness", and thus in most cases it will be unattractive to provide more than three overlying line deflection patterns on the substrate.

If n patterns of the same frequency are to be used, the second pattern should be offset from the first by 1/n times s, the interlineation distance or wavelength. The third pattern should be offset from the first by a distance equal to s(1/n + 1/n). Accordingly, the mth pattern is preferably offset from the first pattern by a distance equal to $\frac{s}{n}(m - 1)$. This offset is equivalent to a phase shift with respect to the first pattern.

The line frequency of one or more of the patterns may be equal, or a low integral multiple of the first pattern. In the general case in which n superimposed patterns having the same orientation and having frequencies which are integral multiples k(i) of the first pattern are to be used, the preferred offset distance, OD(m), of the mth pattern from the first pattern is given by the following formula: $OD(m) = \frac{s}{n} \sum_{i=2}^{m} \frac{1}{k(i)}$, where s equals the interlineation distance. The resulting pattern comprises a series of

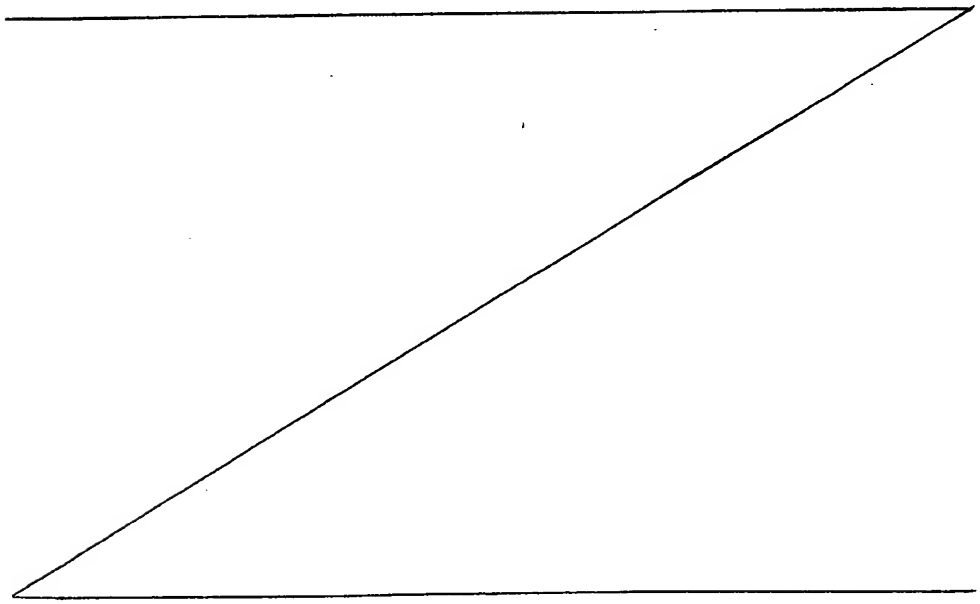
generally parallel lines with a line frequency equal to the sum of the frequencies of the superimposed line deflection patterns.

According to the present invention, a security device is provided comprising a substrate to which overlying line deflection patterns have been applied in accordance with the above-described method. "Security device" includes such things as paper banknotes, share certificates, birth certificates, passports, etc.

"Superimposed" as used herein does not imply any particular sequence of application of the patterns to a substrate. It is a matter of designer's choice which of the superimposed patterns is applied first and which subsequently.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 depicts a finding screen pattern with a regular arrangement of straight parallel lines having the same frequency as the lines of the screen used to generate the line deflection images of Figures 2, 3, 6 and 7.



A

Figure 2 is a line deflection pattern of the word ONE.

Figure 3 is a line deflection pattern of the word TWO, having an angle of orientation and a line frequency identical to those of Figure 2.

Figure 4 is a combination line deflection pattern obtained by superimposing Figure 1 upon Figure 2 and offsetting the images in accordance with the invention.

Figure 5A is the combined line deflection pattern of Figure 4 overlayed with the finding screen of Figure 1 such that the latent image ONE is revealed.

Figure 5B is the combined line deflection pattern of Figure 4 overlayed with the finding screen of Figure 1 such that the latent image TWO is revealed.

Figure 6 is a line deflection pattern of the word ONE.

Figure 7 is a line deflection pattern of the word TWO having the same line frequency as the pattern of Figure 6 but a different angle of orientation.

Figure 8 is a combination line deflection pattern obtained by superimposing Figure 6 upon Figure 7 in accordance with the invention.

Figure 9A is the combined line deflection pattern of Figure 8 overlayed with the finding screen of Figure 1 at substantially the same angle of orientation as the pattern of Figure 6, such that the latent image ONE is revealed.

Figure 9B is the combined line deflection pattern of Figure 8 overlayed with the finding screen of Figure 1 at substantially the same angle of orientation as the

pattern of Figure 7 such that the latent image TWO is revealed.

DETAILED DESCRIPTION OF THE INVENTION

In the detailed description which follows, it should be noted that the drawings used are illustrative of the operation of the invention and are not necessarily representative of what would be typical practical applications of the invention. Typically, the invention would be used to overlay complex line deflection patterns with line frequencies higher than are shown in the drawings. The resulting combined line deflection pattern would be typically of the degree of complexity and line density found in patterns on paper currency and security documents. The drawings of the present application are necessarily simplified and of enlarged scale to facilitate comprehension and satisfactory drawing reproduction.

Figure 1 is a finding screen, or perhaps more accurately a parallel line pattern which, when applied for example to a transparent plastic film, would serve as a finding screen.

Figure 2 is a line deflection pattern of the word ONE having the same line frequency as the finding screen and obtained by the technique taught in the above-mentioned Canadian Patent No. 1,066,109. Figure 3 is a line deflection pattern of the word TWO obtained by that technique, and having the same line frequency and angle of orientation as the pattern of Figure 2.

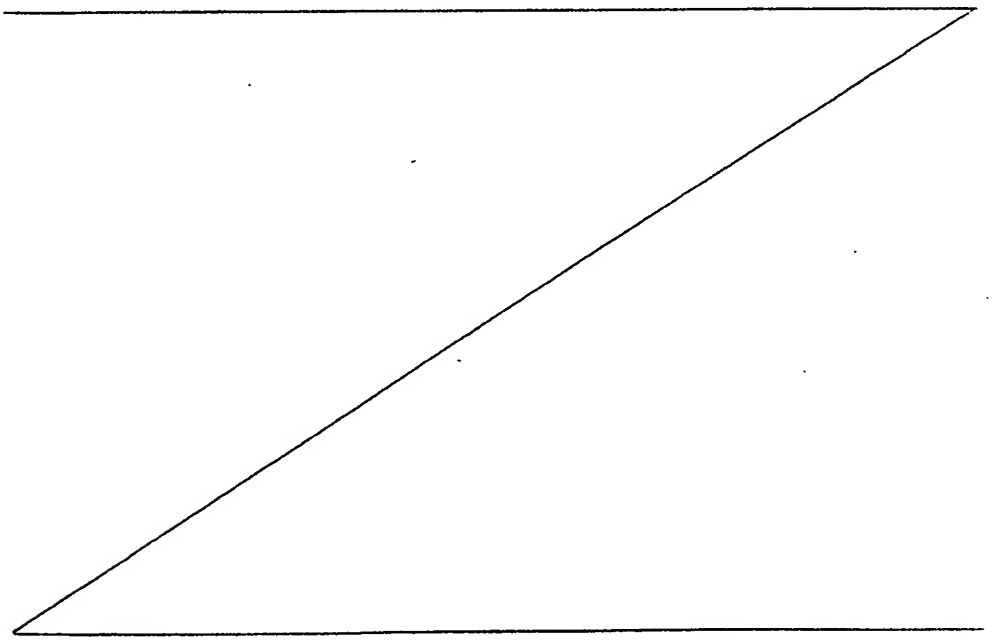
Figure 4 represents the result when Figure 2 is overlayed on Figure 3 and shifted perpendicular to the angle of orientation relative to Figure 3, through a distance equal to 1/2 times the interlineation distance in Figure 2 or Figure 3. The phase of one pattern is thus slightly out of register with the phase of the other. The resulting combination line displacement pattern has a line frequency equal to 2 times the line frequency of any one of the line deflection images overlayed.

As explained above, where two line displacement patterns of different line frequencies are overlayed (i.e., where the frequency of one is an integral multiple of the other) the resulting pattern has a line frequency equal to the sum of the frequencies of the two patterns. In this latter case, the patterns should be phase shifted a distance of $\frac{1}{2k}$ times the interlineation distance of the pattern with the lesser line frequency, where k equals the integral multiple obtained by dividing the line frequency of the pattern of greater line frequency by the line frequency of the pattern of lesser line frequency. In the case where a first pattern is overlayed with a second pattern of twice the line frequency of the first, k = 2 and the second pattern should be phase-shifted $\frac{1}{4}$ the interlineation distance of the first pattern. Where more than two patterns are overlayed and the line frequency or density of one or more patterns is an integral multiple of the other patterns, the mth pattern is preferably phase shifted such that the offset distance of the mth pattern is given by the following formula: $OD(m) = \frac{s}{n} \sum_{i=2}^{l} \frac{1}{k(i)}$. For example, if three patterns are to be overlayed with the second having twice the line frequency of the first and third having three times

the line frequency of the first, the second pattern would be phase shifted $\frac{s}{3} \times \frac{1}{2}$, or $\frac{1}{6}$ times the interlineation distance of the first pattern. The third pattern would be shifted by $\frac{s}{6} + [\frac{s}{3} \times \frac{1}{3}]$, which equals $\frac{s}{6} + \frac{s}{9}$, or $\frac{5}{18}$ times the interlineation distance of the first pattern.

The "hidden" images, namely the words ONE or TWO in Figures 2 and 3, respectively, can be perceived vaguely by the naked eye if viewed at an angle. The combined pattern of Figure 4, however, is more difficult to decipher and a potential copier of Figure 4 might not appreciate the necessity of duplicating the precise line patterns to allow the reading of the two images contained in Figure 4 by means of a finding screen. The difficulty that would be encountered by a counterfeiter increases as the line density used increases and as the complexity of the patterns to be overlayed is increased.

In order to decipher Figure 4, the finding screen of Figure 1 is used. Since the finding screen consists of



a series of straight parallel lines of the same frequency as the line screen used in generating the line deflection images of Figures 2 and 3, it follows that when the finding screen is overlayed on Figure 4 such that the angle of the lines on the finding screen coincides with the angle of the lines on the combined line deflection pattern, the latent images are revealed to the naked eye. By retaining the same angular orientation but changing the relative position of the finding screen, the images ONE and TWO are alternately displayed. Figure 5A illustrates the result when the finding screen is aligned so that the image ONE appears. By shifting the finding screen horizontally a distance of 1/2 of the interlineation distance of either pattern, the image TWO appears, as is illustrated in Figure 5B.

It will be understood that more than two line deflection patterns could be combined in the aforesaid manner. It will also be understood that line deflection patterns of different line frequencies may be overlayed but in that case different finding screens would have to be used, corresponding in line frequency to the line screens used in creating each such line deflection patterns. However, where the line frequency of one line deflection pattern is an integral multiple of the line frequency of the superimposed line deflection pattern, one finding screen only is required. Such a finding screen would have a line frequency equal to the line deflection pattern with the greater line frequency.

Figures 6-9B illustrate another embodiment of the invention. Figure 6 illustrates a line deflection pattern

of the word ONE created by combining a line negative (which is created by using a line screen oriented at an angle of approximately 45° to the right of the vertical) and the corresponding line positive. Similarly, Figure 7 illustrates a line deflection pattern of the word TWO resulting from the use of the line screen oriented at an angle of approximately 45° to the left of the vertical.

Figure 8 represents the resulting combined line displacement pattern when those of Figures 6 and 7 are overlayed. As before, the words ONE and TWO in Figures 6 and 7 can be vaguely perceived by the naked eye. However, the pattern in Figure 8 is virtually devoid of useful information to the unaided observer.

By means of the finding screen illustrated in Figure 1, the information in Figure 8 can be deciphered. As before, the lines of the finding screen must be oriented in the same angular direction as the lines of the pattern. With Figure 4, the relevant angle is 0° (360°) since all the lines are identically angled. With Figure 8 the relevant angles to the vertical are 45° and -45° since the lines of the two patterns combined are generally disposed at these positions. Therefore, by placing the finding screen on the pattern of Figure 8 and rotating the screen through an angle of 45° (as is illustrated in Figure 9A) the word ONE will become visible. Similarly, by rotating the screen a further 90° the word TWO will become visible (as is illustrated in Figure 9B).

As before, it will be understood that different relative angular orientations may be used for the overlayed line displacement patterns. In addition, more than two

line displacement patterns can be overlayed one upon the other in the same location thereby further obscuring the images from the naked eye. Or the line deflection images can be superimposed upon a conventional line engraving, to further obscure the latent images. It will also be understood that two or more line displacement patterns with line frequencies of an integral multiple of one or more of such patterns can be overlayed in different angular orientations and still be deciphered with a single finding screen. Although the number of patterns that can be superimposed is theoretically unlimited, four or five patterns is the practical limit. Multiple overlaying beyond that point would not be useful ordinarily since standard-sized documents thereby created and viewed through a finding screen at normal viewing distance would not be readily decipherable by the naked eye, because of the jumble of lines.

The line deflection patterns illustrated in the drawings can be printed one upon the other in inks of contrasting colors. In the case of lateral displacement and overlaying of two line deflection patterns, each pattern can be printed on the same substrate with a different color. Likewise, in the case of angular displacement and overlay a different color may be used for the printing of each pattern. The use of different colored patterns is especially useful in the production of paper currency and security documents.

This invention may be further adapted to practical use in a number of ways. For example, in the creation of a line negative of a subject, a distorted line

screen with an irregular line pattern may be used to create a distorted pattern. Two or more distorted patterns could then be superimposed and the corresponding images would only be readily recognizable to the unaided eye by use of a finding screen with an irregular line pattern equivalent to the irregular pattern used on the line screen.

Practical applications of the method of this invention include the use of intaglio printing for the imprinting of one or more line deflection patterns and the use of surface printing techniques (e.g. lithography, letterpress) for imprinting other line deflection patterns upon the first pattern printed.

It will be understood that intaglio printing of one or more line deflection patterns may be effected in a color similar to the color of the substrate used. The shadows cast by the undepressed portions of the substrate create the "hidden" image which can be revealed by use of the finding screen. Similarly, embossment of the line deflection patterns upon a substrate may be effected.

The use of a translucent substrate allows line deflection patterns to be printed on one side of the substrate and a complementary finding screen to be printed on the other side in a cooperative position with one of the patterns printed. The "hidden" image could then be viewed when light is transmitted through the substrate. The "hidden" images in any overlayed pattern could be revealed by using a separate finding screen.

This invention may also be adapted to create security documents such as identification cards. The pattern created by overlayed line deflection patterns can

be recorded in a photosensitive medium through a lens system or by contact exposure. The pattern could be stored as a master photographic transparency in one or more colors. When creating the identification card, or other such documents, the master photographic transparency could be simulataneously exposed with the additional information photographed for the card. Alternatively, exposure could be effected before or after the additional information is photographed for the card. A possible overlayed pattern for such use could be the overlaying of separate line deflection patterns of an individual in profile and in frontal view. Verification of a card with such a pattern would require the use of a finding screen.

Variations in the techniques described above may occur to those skilled in the art. The scope of the invention is not to be considered limited by specific examples discussed above but is as set forth in the appended claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A method of generating overlying line deflection patterns on a substrate for security or authentication purposes or the like, comprising

applying to the substrate a first line deflection pattern producing a first visible image when overlain by a finding screen, and

applying to the substrate a second line deflection pattern producing a second visible image when overlain by a finding screen so as to overlie at least a substantial portion of the first line deflection pattern,

wherein the second line deflection pattern has at least one of its phase and its angle of orientation different from the counterpart characteristic of the first line deflection pattern thereby enabling discrimination of the two visible images with the aid of the finding screen.

2. A method as defined in claim 1, wherein one of the patterns is applied by printing and the other is applied by embossing.

3. A method as defined in claim 1, wherein both patterns are applied by printing.

4. A method as defined in claim 1, wherein the first and second line deflection patterns have substantially the same frequency.

5. A method as defined in claim 1, wherein the angle of orientation of the second pattern is different from the angle of orientation of the first pattern.

6. A method as defined in claim 5, wherein the first and second line deflection patterns have substantially the same frequency.

7. A method as defined in claim 1, wherein the angle of orientation of the two patterns is substantially the same and the phase of the second pattern is different from the phase of the first pattern.

8. A method as defined in claim 7, wherein the first and second line deflection patterns have substantially the same frequency.

9. A method as defined in claim 8, wherein the first pattern is offset from the second pattern by approximately half the line spacing of either pattern.

10. A method as defined in claim 3, wherein the patterns are printed in inks of different colors.

11. A method as defined in claim 10, wherein the first and second line deflection patterns have substantially the same frequency.

12. A method as defined in claim 1, wherein the substrate is a photosensitive medium.

13. A security device comprising a substrate having applied thereto a first line deflection pattern bearing a first visible image when overlain by a finding screen, and

having applied thereto a second line deflection pattern bearing a second visible image when overlain by a finding screen, the second pattern overlying at least a substantial portion of the first line deflection pattern,

wherein the second line deflection pattern has at least one of its phase and its angle of orientation different from the counterpart characteristic of the first line deflection pattern thereby enabling discrimination of the two visible images with the aid of the finding screen.

14. A security device as defined in claim 13, wherein the angle of orientation of the second pattern is different from the angle of orientation of the first pattern.

15. A security device as defined in claim 13, wherein the angle of orientation of the two patterns is substantially the same and the phase of the second pattern is different from the phase of the first pattern.

16. A security device as defined in claim 13, 14 or 15, wherein the first and second line deflection patterns have substantially the same frequency.

17. A security device as defined by claim 13, wherein one of the patterns is applied by printing and the other applied by embossing.

18. A security device as defined by claim 13, wherein both patterns are applied by printing.

19. A security device as defined by claim 15, wherein the first pattern is offset from the second pattern by approximately half the line spacing of either pattern.

Barrigar & Oyen
700-130 Slater Street
Ottawa, Ontario
K1P 6E2
Agents for the Applicant

FIG. 1

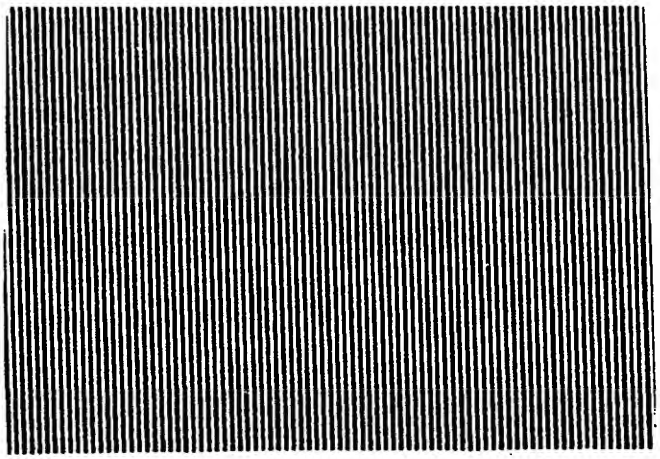


FIG. 2

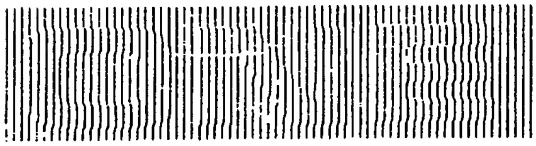


FIG. 3

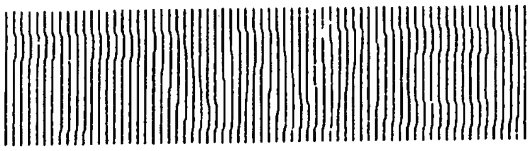


FIG. 4

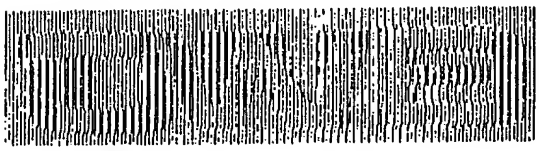


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FIG. 5A

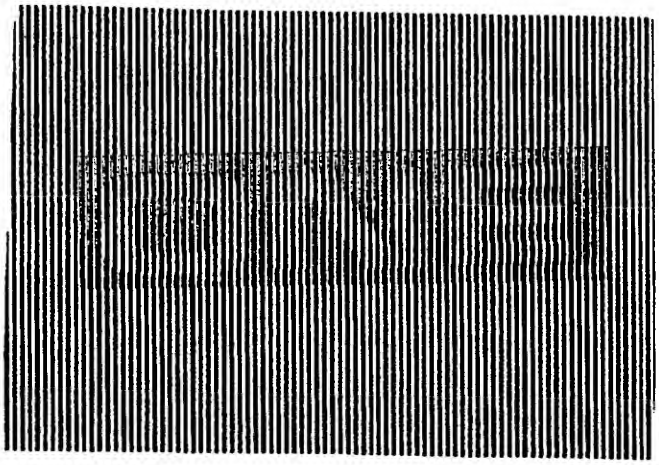

FIG. 5B

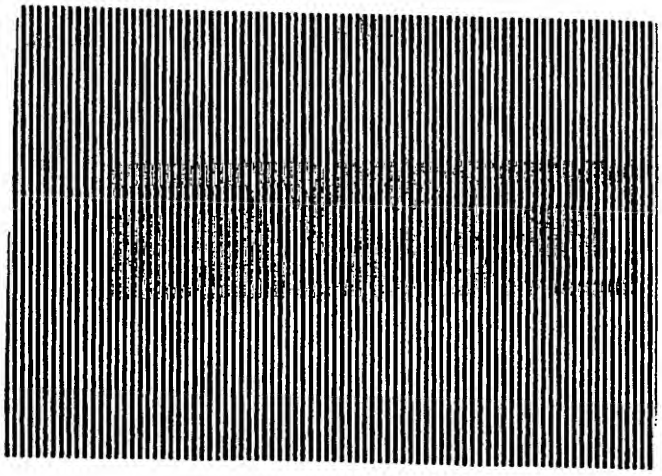

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FIG.6

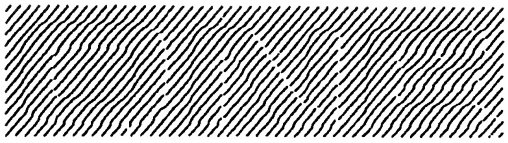

FIG.7

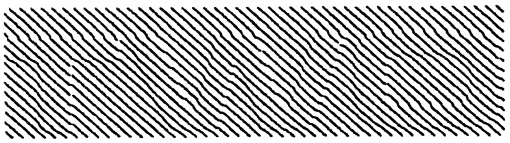

FIG.8

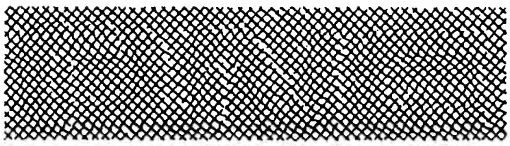

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FIG. 9A

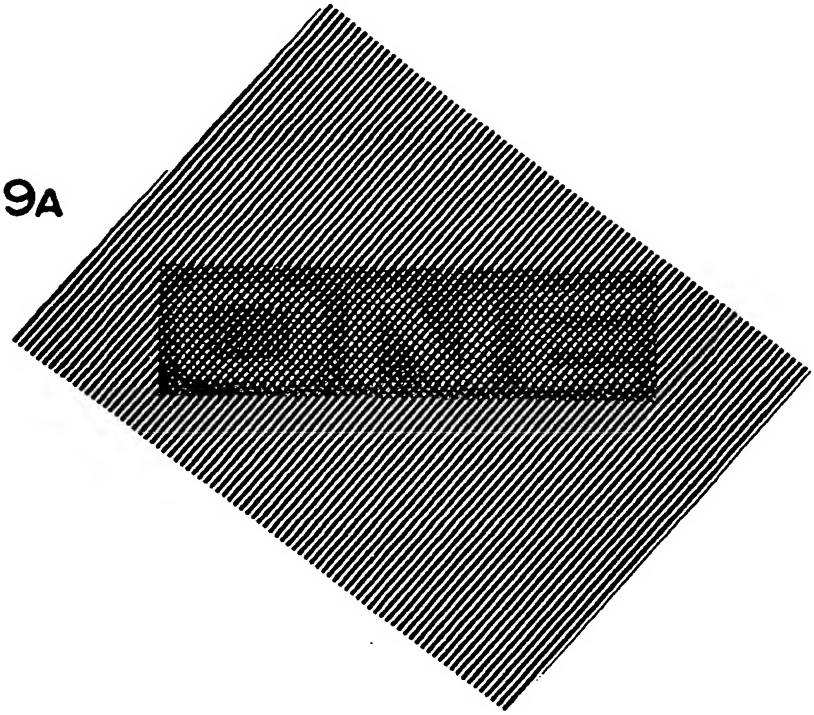
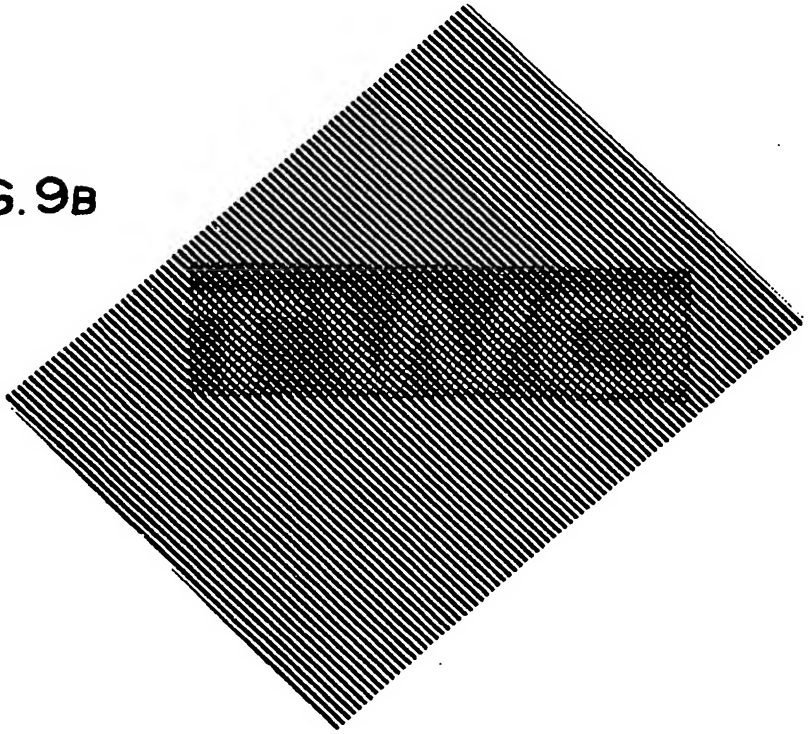


FIG. 9B



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